

15595 and 15596
Vuggy Vitrophyric Pigeonite Basalt
237.6 and 224.8 grams



Figure 1: Photo of 15595. Sample is about 9 cm across. NASA S71-44491.



Figure 2: Photo of 15596 showing surface that was exposed to micrometeorites. NASA S71-47070. Sample is 7 cm across.

Introduction

Lunar samples 15595 and 15596 were chipped from a small boulder near the edge of Hadley Rille in an area called The Terrace (see transcript in 15597). The boulder is thought to be “bedrock” in this region (equivalent to the outcrops seen in telephoto of the other

side of the Rille (figure 2). The lunar regolith was thin in this area, with abundant rock samples (basalts) exposed (Swann et al. 1971). However, both pigeonite basalt and olivine-normative basalts were found in this location.

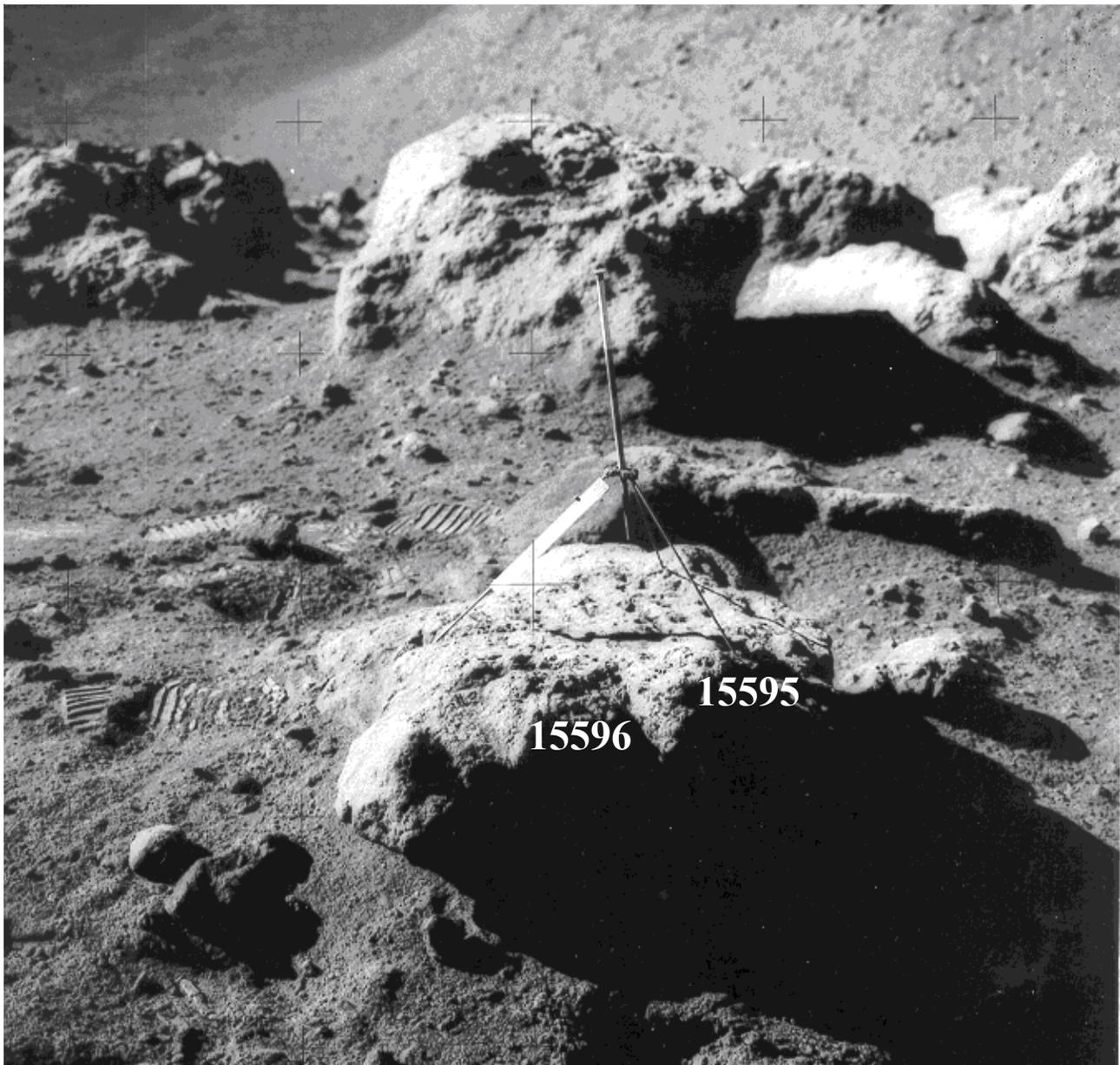


Figure 3: Boulder sampled with 15595 and 15596 (location indicated). AS15-82-11143.

Petrography

Ryder (1985) describe both 15595 and 15596 as a “fine-grained, porphyritic mare basalt with conspicuously irregularly distributed vugs (figures 1 and 2). Pigeonite phenocrysts are set in as spherulitic, almost vitrophyric groundmass. - - - The sample is olive gray to olive black, angular, and tough. The broken surface is hackly, the other are smoothed to irregular and have zap pits (micrometeorite craters)”. Vugs make up 15 to 30 % of volume.

15596 has the same texture but with somewhat larger pyroxenes, and a groundmass that is more crystalline.

Brown et al. (1972) described the groundmass as made up of “clinopyroxene, plagioclase and opaques, with occasional rare zoned olivine and Cr-spinel microphenocrysts.”

The larger pyroxene phenocrysts have homogeneous pigeonite cores, with a sharp transition to sub-calcic augite rims. The fine groundmass pyroxene are zoned to Fe-rich pyroxferroite (Brown et al. 1973).

Lofgren et al. (1975, 1976) and Grove and Walker (1977) have studied the cooling history of vitrophyric pigeonite basalts.



Figure 4: Telephoto of opposite side of Hadley Rille showing thinning of regolith and layered outcrop of basalt, possibly similar to sample collection side of 15595. NASA AS15-89-12045

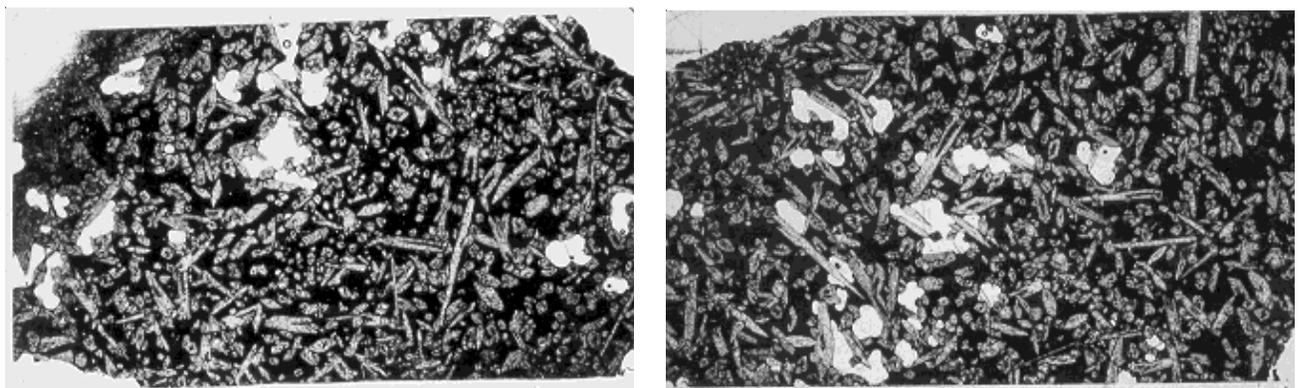


Figure 5: Thin section photos of 15595,39 and 15595,37. Scale is about 1 cm.

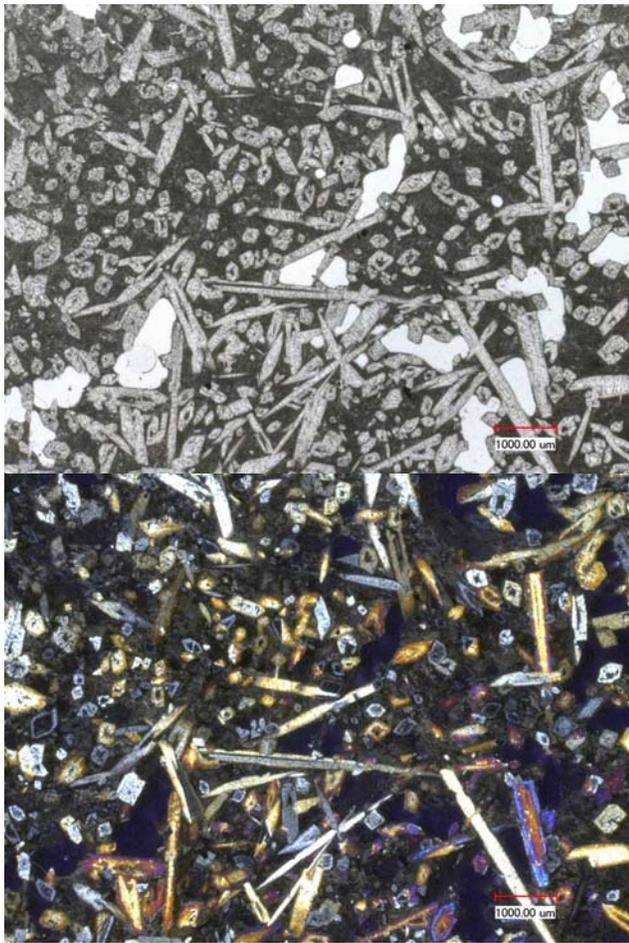


Figure 6: Photomicrographs of 15595,33 by C Meyer @30x (bottom is with crossed polarizers).

Chemistry

Fruchter et al. (1973) and Chappell and Green (1973) analyzed 15595 (figures 7 and 8). Rhodes and Blanchard (1983) reported that they had analyzed 15596, but gave no data.

Cosmogenic isotopes and exposure ages

Behrmann et al. (1972) and Pepin et al. (1974) determined a cosmic ray exposure age of 110 m.y. by ⁸¹Kr method.

Mineralogical Mode of 15595

	Sample Catalog Butler 1971	Papike et al. 1976	Grove and Walker 1977	15596
Olivine	3-5 %			
Pyroxene	60-65	48.1	52	41
Plagioclase	35			
Opaque	1	0.3		0.2
Silica				
Groundmass		51.6	48	59

Lunar Basalts

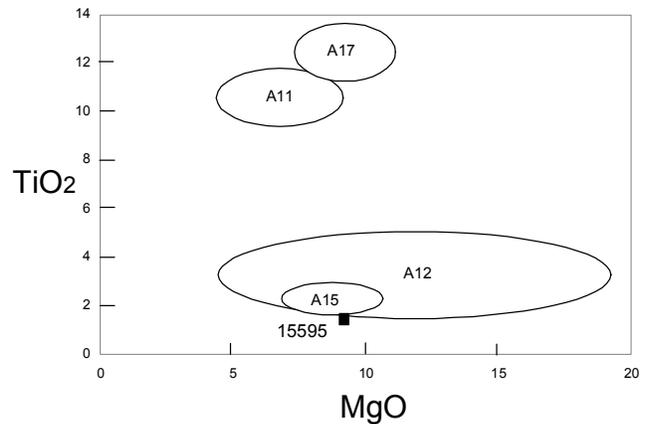


Figure 7: Chemical composition of 15595 compared with that of other lunar basalts.

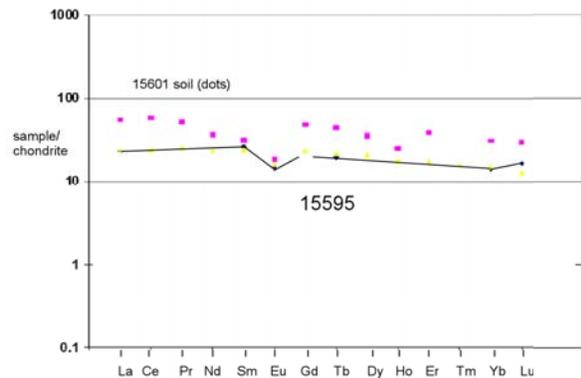


Figure 8: Normalized rare-earth-element diagram for 15595 (data by Fruchter et al. 1973) compared with 15601 soil.

Other Studies

Behrmann et al. (1972), Pepin et al. (1974) and Drozd et al. (1974) measured the isotopic ratios of all of the rare gas elements and studied the spallation reactions of the rock with solar and galactic cosmic rays.

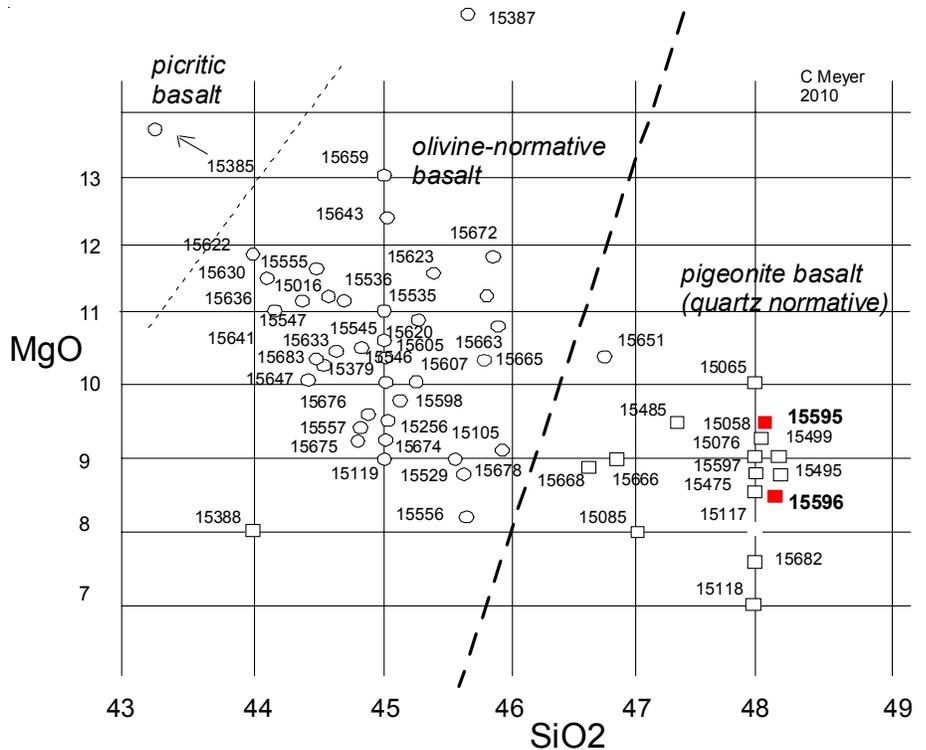
Gose et al. (1972) and Pearce et al. (1973) measured the magnetic properties of 15595 and 15596, finding that the direction of remanent magnetizations was different for the two sample (of the same boulder?).

Table 1. Chemical composition of 15595.

reference	Chappell73	Fruchter73
weight		
SiO2 %	48.07	(a)
TiO2	1.77	(a) 1.68 (b)
Al2O3	9.06	(a) 9.07 (b)
FeO	20.23	(a) 18.91 (b)
MnO	0.3	(a)
MgO	9.21	(a)
CaO	10.52	(a)
Na2O	0.35	(a) 0.286 (b)
K2O	0.05	(a)
P2O5	0.07	(a)
S %	0.05	(a)
sum		

Sc ppm		45	(b)
V			
Cr	3558	(a) 3450	(b)
Co		42	(b)
Ni			
Cu			
Zn			
Ga	2.8	(a)	
Ge ppb			
As			
Se			
Rb	0.72	(a)	
Sr	103.8	(a)	
Y	26	(a)	
Zr	94	(a)	
Nb	8	(a)	
Mo			
Ru			
Rh			
Pd ppb			
Ag ppb			
Cd ppb			
In ppb			
Sn ppb			
Sb ppb			
Te ppb			
Cs ppm			
Ba			
La		5.4	(b)
Ce			
Pr			
Nd			
Sm		3.9	(b)
Eu		0.81	(b)
Gd			
Tb		0.7	(b)
Dy			
Ho			
Er			
Tm			
Yb		2.3	(b)
Lu		0.4	(b)
Hf		2	(b)
Ta		0.35	(b)
W ppb			
Re ppb			
Os ppb			
Ir ppb			
Pt ppb			
Au ppb			
Th ppm			
U ppm			

technique: (a) XRF, (b) INAA



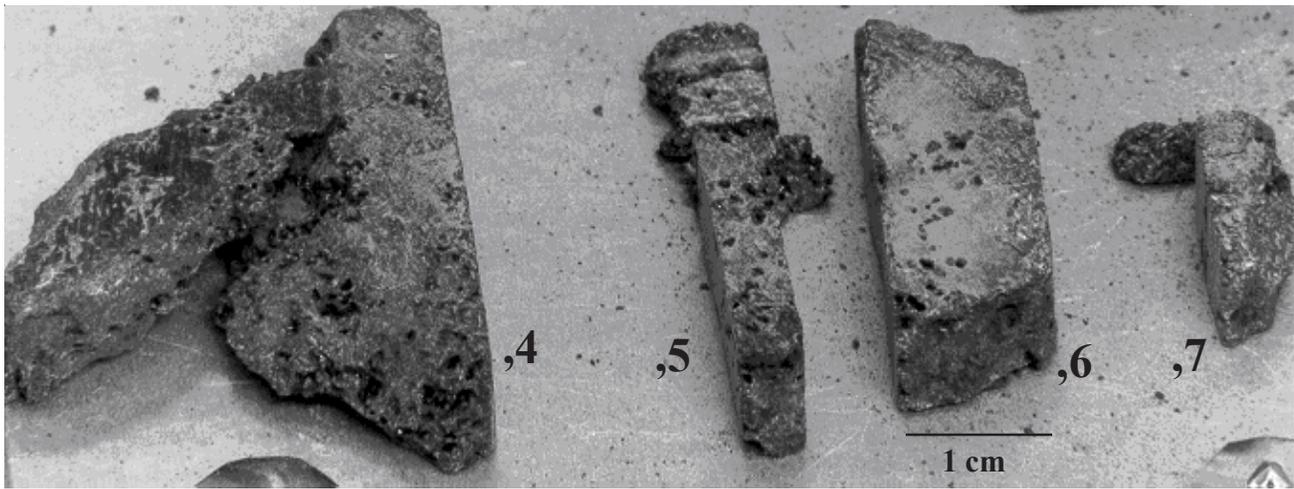
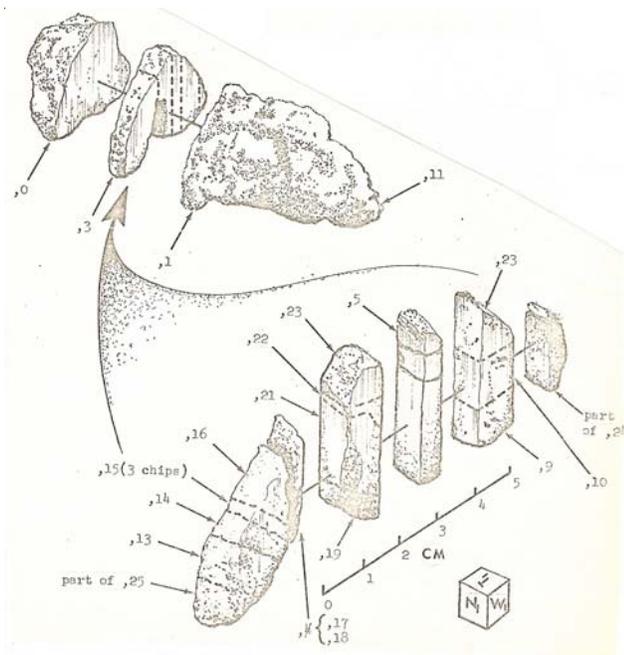
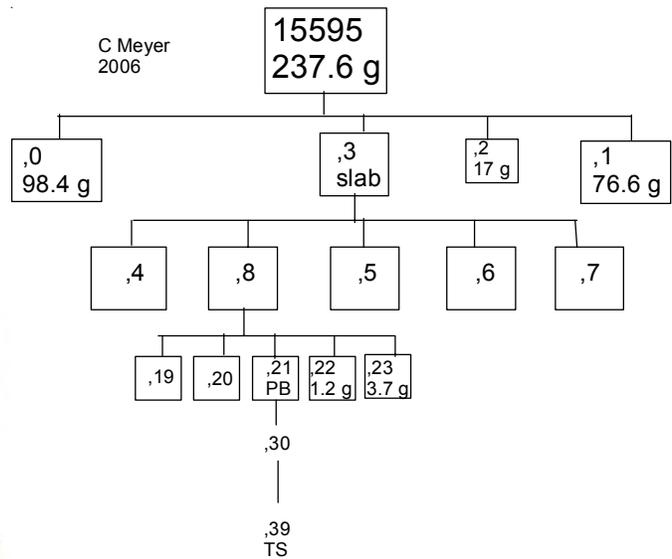


Figure 9: Group photo of pieces cut from slab cut from 15595. NASA S71-60629.

Sato et al. (1973) measured the oxygen fugacity as a function of temperature by an *insitu* technique.

Processing

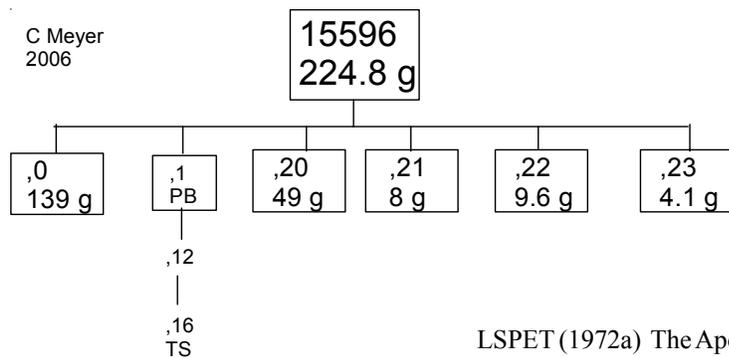
A slab was cut through the middle of 15595 (figure 9) and cut into columns. 15596 remains essentially intact. There are 10 thin sections for 15595 and 5 for 15596.



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